

E. R. Phoney

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MINING METHODS AT THE PAGE MINE
OF THE FEDERAL MINING AND SMELTING CO.,
PAGE, IDAHO



BY

J. E. BERG

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MINING METHODS AT THE PAGE MINE
OF THE FEDERAL MINING AND SMELTING CO.,
PAGE, IDAHO¹

By J. E. Berg²

INTRODUCTION

This paper³ describing the mining methods at the Page mine operated by the Federal Mining & Smelting Co., is one of a series being prepared by the United States Bureau of Mines on mining practices, methods, and costs in the various mining districts of the United States.

The Page mine is the most westerly of the producing lead-silver-zinc mines in the Coeur d'Alene mining district of Idaho, being situated 5 miles west of the city of Kellogg and at an elevation of 2,677 feet above sea level. It may be classed as one of the now active producers of the district and owes its present activity largely to the development of flotation.

The daily tonnage produced at the Page mine is 300 tons. Mine run of ore averages 8.5 per cent lead, 2.8 per cent zinc, and 2.6 ounces of silver per ton. A square-set-and-fill method of mining is employed.

ACKNOWLEDGMENTS

The writer is indebted to the authors of U. S. Geological Survey Bulletin 732 for some of the geological data, and to Sergey Lavrov, mine engineer, and R. L. Dean, assistant engineer, at the Page mine for assistance in preparing maps and obtaining data.

HISTORY

Prior to 1906 considerable development had been done on what is now the Page-Blackhawk-Wyoming group of mines. In that year, the Page, then known as the Corrigan property, was purchased by the Federal Mining and Smelting Co., and in the period up to 1911 a large amount of development work was performed,

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- 1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6372."
 - 2 - Mine superintendent, Page Mine Federal Mining and Smelter Co.
 - 3 - Written under the direction of H. G. Washburn, one of the consulting engineers, U. S. Bureau of Mines, and general manager, Federal Mining and Smelting Co., Wallace, Idaho.

including the sinking of the present working shaft to the 600 level. The ores which were developed up to that time and prior to the advent of flotation were not responsive to gravity concentration, which fact, together with low metal prices then prevailing, caused the work to be discontinued. Due to the improvement in metallurgy and the desire to do additional development work, the mine was dewatered in 1925. The results were so encouraging that a 300-ton daily capacity flotation mill was constructed and put in operation in December, 1926.

GEOLOGY AND ORE DEPOSITS

There are two distinct fissure veins--namely, the Tony and Curlew (fig. 1). These lie in the Revett-Burke quartzites of Algonkian age, strike about south 70 to 80° west, and have a southerly dip of from 40 to 60°. The Tony vein on the 900 level lies about 350 feet in the footwall and at the western extremity of the Curlew vein; it has been developed for a length of 1,000 feet and is the chief ore-producing vein. The Curlew vein has been drifted on for a distance of 4,000 feet. Both veins are terminated at their western extremities by a thrust fault which strikes north and dips 42° west, thereby producing a fault contact between the ore-bearing Revett-Burke quartzites and the Prichard slates (fig. 2). Evidence is not complete, but it points to premineral faulting. No prospecting has as yet been done by this company west of this fault contact.

The Tony and Curlew veins are thought to be an extension of the broad Bunker Hill ore zone and like the latter lie on the south side of the Osburn fault, the main marker and largest fault displacement in the district. A diabase dike is observed in the east workings, but it appears to have no effect upon the vein or its mineralization. There are no well-defined walls. The enclosing quartzites are broken and shattered to produce a zone extending as much as 20 to 30 feet into the hanging and footwalls of the vein proper; this causes heavy swelling ground along drifts and necessitates square-set mining and closely filled stopes.

The veins show poor outcrops. Mineralization was found to become weaker as upper level stopes were advanced, so that little mining has been done above the 300 level, because of the low grade of the ore.

The ore minerals are galena and sphalerite associated with some siderite. While the sulphides do occur in places in relatively coarsely crystallized form, most of the ore, more particularly in the Curlew vein, is a very fine-grained, almost amorphous mixture of lead and zinc and may often be classified as "rock" instead of ore by anyone not thoroughly familiar with the occurrence.

Some sorting is done underground, but in the main the ore breaks so fine that material is either rejected for filling or sent out as ore. The vein on both strike and dip pinches to a mere gouge and swells at times to a maximum thickness of 20 feet. Small irregular patches and bodies of ore are occasionally found running back into the hanging wall of the vein but these are confined to the fractured zone.

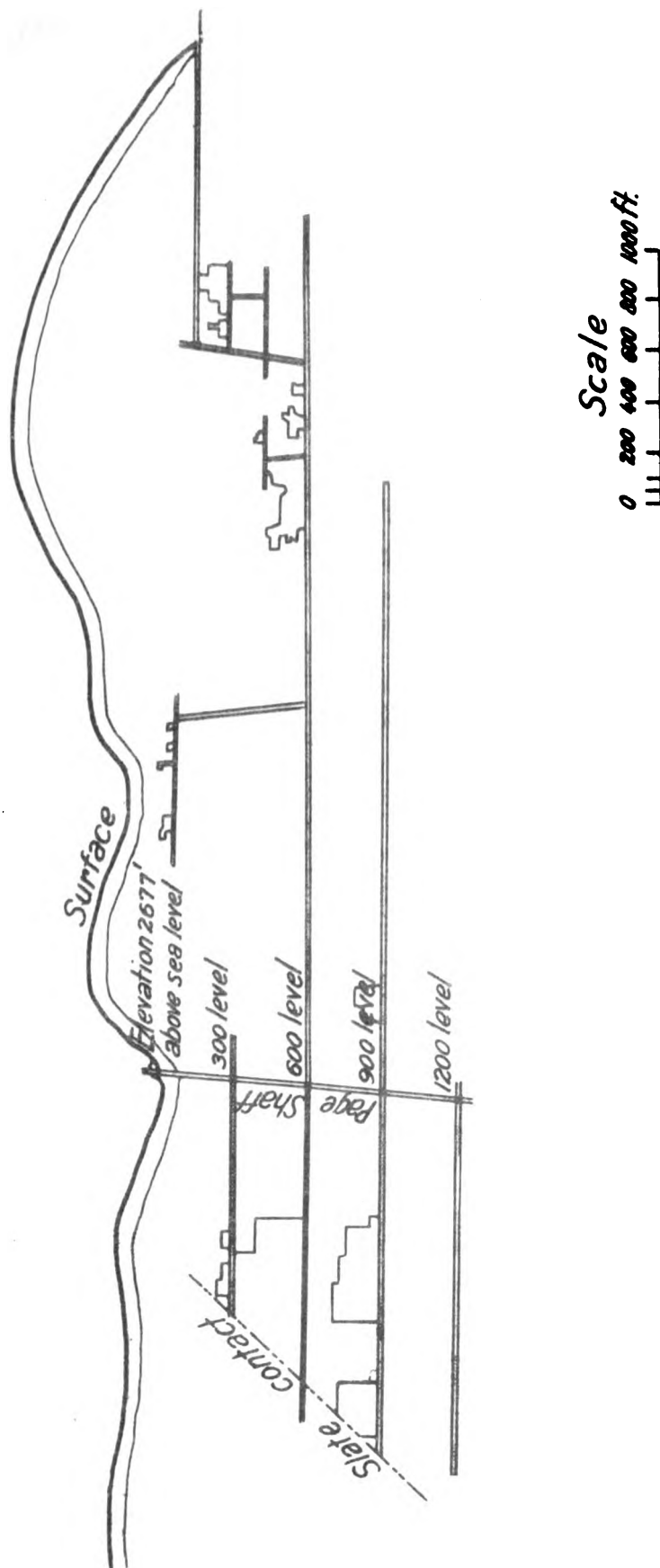
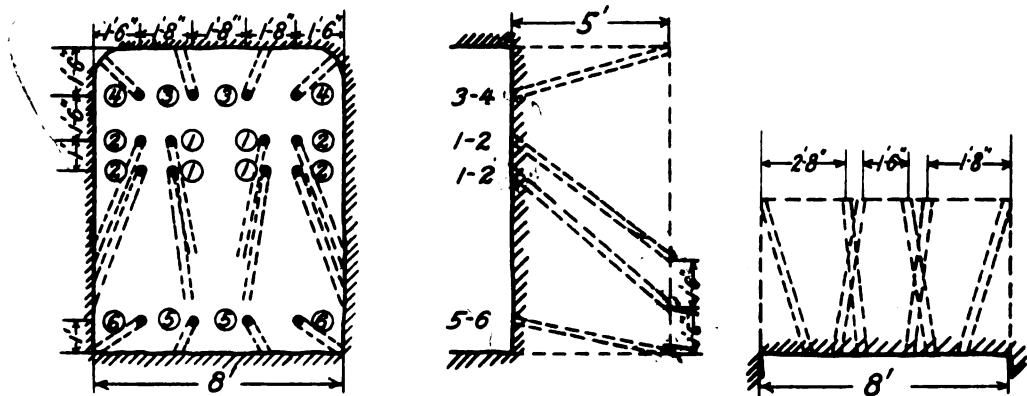
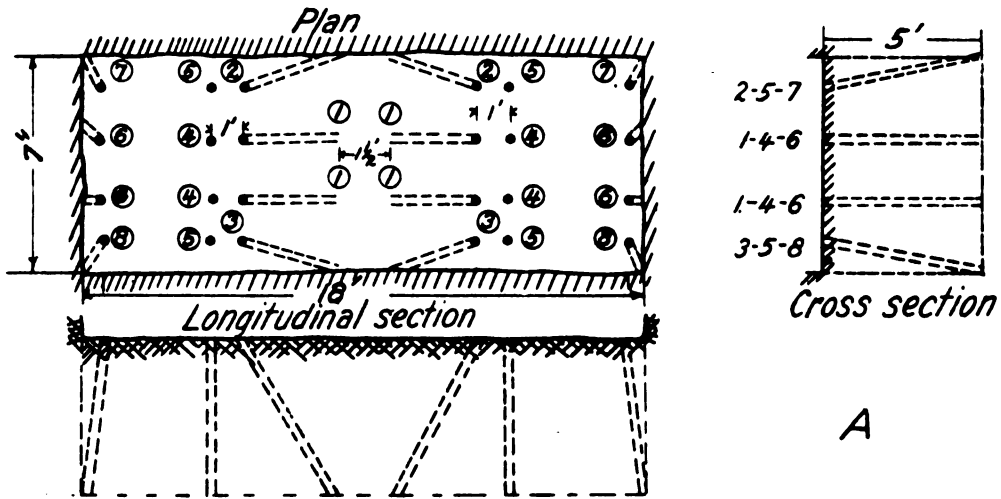


Figure 2.- Longitudinal section on 50° plane



8 x 9.5 ft. drifts 5 ft. break 16 holes

Scale

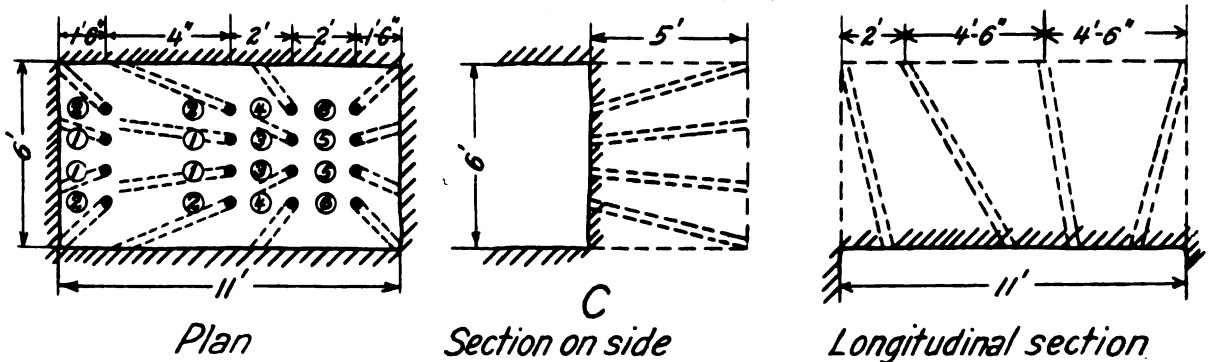
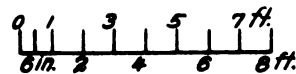


Figure 3.-Drilling and order of blasting in 3-compartment inclined shaft

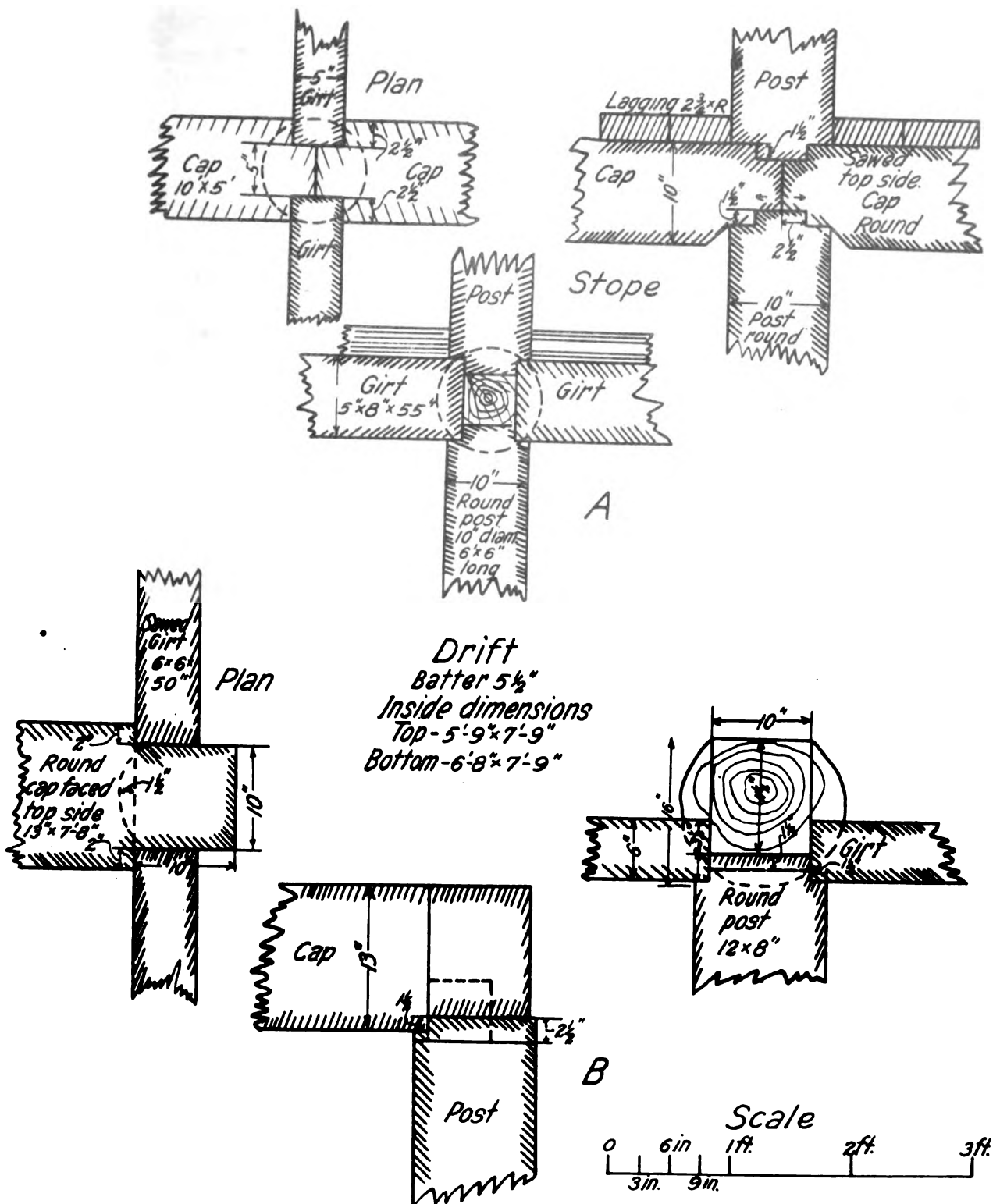


Figure 4.-Timber framing details

DEVELOPMENT AND PROSPECTING

Development of each additional level entails the sinking of the main shaft a slope distance of 300 feet, and crosscutting to and drifting upon the veins to their limits. An ore shoot is opened by means of working raises spaced about 140 feet apart. Test raises in the hanging wall, and crosscuts into the footwall at frequent intervals from these raises as well as from the stopes serve to prospect the ore zone for its full width and also supply waste for filling. Crosscuts at frequent intervals are also run from the drifts into the hanging and foot walls for prospecting purposes. Some diamond drilling has been done at this property. The principal objections to this form of exploration are that as the vein filling is soft, cores are not obtained, and the holes cave. A long-hole machine has been used for prospecting, but the formation is so siliceous and hard away from the ore zone that the range of the machine is very limited and progress slow and costly.

SAMPLING

Where ore is encountered in development drifts and raises, cut samples are taken at 10-foot intervals, and assays are made for lead and zinc with occasional assays on composites for silver. The sample widths and assays are posted on sample maps. No regular sampling is done in stoping, as familiarity with the ore requires only an inspection and careful watching by bosses. In estimating tonnages a factor of 9 cubic feet to the ton is used.

METHOD OF DEVELOPMENT AND MINING

Drifts, Shaft, and Raises

The level interval is 300 feet. The lowest level is now 1,200 feet, slope distance, below the collar of the shaft. Development, drifting and raising are done under a contract system for the labor with all supplies furnished. Mechanical shovelling machines are used in contract drifts. Drifts are standardized to 6 by 8 feet inside the timber. Drifts are advanced 5 feet per 8-hour shift, using three men and a mechanical loader. A drift round will average 16 holes, using the down cut (fig. 3 b). Light drifting machines and 1 1/4 inch round hollow steel are used.

Round timber is used in stopes and drifts; the supply is plentiful at reasonable prices. All timber framing is done by a small sawmill plant at the shaft collar. This sawmill also furnishes practically all sawed lagging, slabs, and dimension material, such as cribbing, shaft and raise sets, and wedges. Drift sets are of selected fir, with 10 to 12 inch posts and 14 to 16 inch caps, spaced at 5-foot centers. Figure 4-b shows the timber details. Slab and timber bulkheading to the ground over each set is required in drifts on the vein. Some trouble is experienced due to down weight on posts, and swelling at the bottom causes buckling and the breaking of sills; this latter condition is remedied by the use of a spreader in place of a sill.

The main shaft is inclined, rectangular, 7 by 18 feet overall in size, and contains two skip compartments and one manway-pipe compartment. When sinking, a progress of 5 feet per day is made by four men working on each of three

shifts. The broken rock is shovelled directly into the skip and hoisted to the surface. A light drifting machine with jack-hammer mounting is used for drilling. A round consists of 20 holes drilled with a "V" cut (fig. 3 a). One-inch hollow hexagon drill steel with a 2 1/4 inch-gauge for starter bits and 1/8 inch reduction for each change is used. The rounds are blasted electrically.

Raises contain two compartments (fig. 5); the ladderway occupies one-half of a compartment, and the other half is used as a slide for hauling up material and supplies in a so-called "pickle boat" sliding on a planked bottom (fig. 6). Wet stopers with 1-inch quarter octagon steel are used for drilling. A 16-hole round is required to break a 6 by 11 foot opening (fig. 3 c). A progress of 5 feet per shift is made with three men who timber, drill, and blast.

Stoping

A crushed, broken ore zone with variable widths and dips of the vein makes it necessary to use the square-set stoping method. Breast stoping with light drills is preferred to overhead stoping with stoper drills, as it gives better control of breaking and eliminates heavy steel losses and large stoper-machine repairs.

Stopes are carried up in blocks about 250 feet in length and are taken in one lift of 300 feet. The main working chute raises are spaced 140 feet apart. Ore passes are spaced 35 feet apart and cribbed. Chutes are occasionally so flat due to irregularities in the dip of the vein that it becomes necessary to flood them with water to make the broken ore run. A minimum of 40° dip is allowed in chute construction.

Upon opening a first floor, 12 by 12 inch sheeting caps are put in, 12 inches above the main or drift cap. This permits repair to drift timber without loss of head clearance. Filling is also supported by the extra cap, and the first floor directly over the drift is left open to facilitate repair work (fig. 7). New floors are begun at the main raises.

Square-sets are standard (fig. 4 a). Stope caps will average 12 inches in diameter and posts 9 inches; girts are of 5 by 8 inch material sawed to eliminate the necessity of framing them. The ground is so heavy that timber is placed as soon as room is made for a set. The operation consists of drilling, blasting, (the broken ore being allowed to fall to the floor below) and timbering. Open space above every set is tightly cribbed with slabs as soon as the set is put in. This slab crib acts as a cushion for the stope timber and helps to keep the weight from settling on the timber until the ground pressure is relieved by the starting of a new top floor.

Some sorting is done, principally with a shovel on account of the fineness of the broken material. Wheelbarrows are used except where ore can be blasted or run by gravity into the chutes. It is desirable to keep stopes filled to within three floors or less of the back of the stope. Crosscuts into the footwall for waste are started about 5 by 7 feet and the section of the face enlarged to 8 by 12 feet when at a distance of 25 to 30 feet from the stope. Waste from these crosscuts is placed in fills by use of single drum tugger hoists, using 3/8-inch cable and the ordinary drag scraper. Similarly, in short prospect

PRECIOUS AND ORNAMENTAL STONES OF RUSSIA.

SERGEY E. LAVROV.

AN attempt to estimate the economic value of the deposits of precious and ornamental stones in a country presents many difficulties because of (1) the ever changing fads and fancies affecting the selling price of gems, and (2) the nature of the mineral deposits from which gems are obtained.

The price of gems, like that of every other commodity, follows the law of supply and demand. The demand for a gem depends not only upon the beauty and rarity of the stone but is also quite frequently stimulated by artful methods and by psychological manifestations. A striking example of a psychological factor influencing the gem market is the late war. During that time the ruby became exceedingly unpopular in America, whereas in Russia, due to the Revolution, the red stones were in great demand. Clever advertising also plays an important rôle. For example, the ever increasing popularity of the diamond may be attributed, to a great extent, to clever advertising. Excessive zeal on the part of exploiters also has its effects. Commonly, a valuable gem may drop considerably in the price due to over-production. Only strict control by well organized producers and distributors can prevent the pitfalls of over-supply and its consequences.

The mode of occurrence of precious stones influences the valuation of their deposits. Gem minerals are most often found in pegmatite dikes, or are derived from alluvial deposits that are the product of the mechanical concentration of disintegrated dikes, sheets, pipes, and other intrusive masses of igneous rocks. The pegmatite dikes, which are commonly composed of coarse crystalline minerals, develop under favorable circumstances enormously large crystals. Irregularities in the size of their components are characteristic of pegmatite dikes, and their distribution may be

very erratic. These eccentricities present a serious difficulty in arriving at an accurate valuation of a gemmiferous deposit.

The enormous popularity which the diamond enjoys places all the other gems in a position where their bid for favor is greatly overshadowed. A clearer picture of this relationship can be seen from the following estimate. Diamonds valued at \$4,000,000,000 are worn in the United States. In 1928 about \$57,000,000 worth of these gems, comprising about 1.4 per cent. of the total value of imports, were shipped into the country. The other precious stones imported were valued at only 9.7 per cent. of the value of the imported diamonds.

Bearing in mind all the above-mentioned factors, it is possible to analyze comprehensively the deposits of precious and ornamental stones in a country. Russia has deposits of both the precious and ornamental stones in appreciable quantities (see Table I.). By subdividing all stones of economic importance into two major divisions: (1) gems, (2) ornamental stones, the evaluation of the deposits is simplified.

TABLE I.

<i>Mineral</i>	<i>Chemical composition</i>	<i>Locality</i>	<i>Probable yearly production, carats</i>	<i>Supplies carats</i>
Emerald	$\text{Be}_3\text{Al}_2(\text{SiO}_3)_4$	Emerald Mine, Ural.	100,000	10,000,000
Alexandrite	$\text{Be}_3\text{Al}_2\text{O}_4$	" " "	1,000	100,000
Phenacite	Be_2SiO_4	" " "	5,000	7,000
Demantoid	$3\text{CaOFe}_2\text{O}_33\text{SiO}_2$	Tažil, Sisert Distr.	25,000	Unknown
Vorobyevite	$\text{Be}_2\text{Al}_2\text{SiO}_2$	Savatievo, Trans-Baikal	500	Small
Beryl	$\text{Be}_3\text{Al}_2(\text{SiO}_3)_4$	Mursinka, Trans-Baikal	10,000	Medium
Topaz	$(\text{AlF})_2\text{SiO}_4$	Mursinka, Trans-Baikal	1,000	"
Tourmaline	$\text{H}_3\text{Al}_2(\text{B.OH})_2\text{Si}_2\text{O}_{10}$	Mid. Ural and Trans-Baikal	8,000	"
			<i>Production in pounds</i>	<i>Pounds</i>
Amethyst	SiO_2	Mursinka District	200	Medium
Smoky Quartz	SiO_2	Middle Ural	540	"
Lazurite	$\text{Na}_2(\text{Na.S. Al})\text{Al}_2(\text{SiO}_4)_2$	Baikal District	3,600	"
Nephrite	CaMgFe Amphibole	Sayan Mountains	20,000	"
Marble Onyx	Calc. Carb.	Ahalzih, Armenia	10,000	"
Vesuvianite	Basic Calc. Al. Sil.	Ural Mountains	2,000	Large
Amazonite	Plagioclase	Ural, Imen Mts.	4,000	Large
Beloretsk Quartz	SiO_2	Altai Mts.	18,000 Lbs.	Large
Jasper	SiO_2	Altai Mts.	36,000	Large
Serpentine	Mg. Silicate	Mid Ural	7,200	Medium
Gagat	Hydr. Sil. of Mg and Mn	Balahansk, Irkutsk Distr.	10,800	Large
Obsidian	SiO_2	Georgia	7,200	Large
Selenite	$\text{CaSO}_42\text{H}_2\text{O}$	Kama river	72,000	Large
Aventurine	Sil. Al and Na Plagioclase	S. Ural	3,800	Medium
Labradorite	Plagioclase	Kiev, Volinsk Distr.	1,000 Tons	Large

GEMS.

Precious stones of first magnitude and of which the supply is limited, such as the emerald, alexandrite, demantoid, vorobyevite, phenacite and sapphire are classified as gems. Stones such as topaz, tourmaline, amethyst, nephrite, malachite and lazurite, which are of mediocre value, are also considered in the gem group. Ornamental stones include the marble onyx, vesuvianite, amazonite, labradorite, jasper, serpentine, selenite, obsidian, hornstone, aventurine, and others.

Emerald.—One of the most important gems is undoubtedly the emerald from the Ural Emerald Mine. It is a beautiful gem of bright emerald-green color. It occurs in mica schist. Professor A. E. Fersman estimates that from the opening of the mine in 1830 up to the present time 36,000 pounds have been produced but only 500,000 carats were available for cutting purposes. Taking \$7.50 per carat as an average price, the sum of \$3,750,000 was obtained for that period. Since no definite system was followed in exploiting the Emerald Mine, some levels are worked out to a greater extent than others, making it difficult to give an estimate of the total contents of the deposit. A modest estimate, however, reveals the supply to be at least 10,000,000 carats suitable for cutting, which at \$7.50 per carat amounts to \$75,000,000. Due to the cessation of operations in Colombia and to the poor grade of emeralds produced in Alexander Co., Carolina, and in Australia, the chances are that prices will be higher, and that a total of \$100,000,000 might be obtained for the Emerald Mine deposits. The yearly rate of production for two shafts and six working faces is about 100,000 carats.

Alexandrite.—This gem, of emerald-green color in daylight and beautiful columbine red by transmitted light, is found in association with the emerald at the Emerald Mine in the Ural Mountains. It composes only about 1 per cent. of the emeralds produced, hence its high price.

Phenacite.—Varying from a colorless gem to one of bright wine-yellow, pale rose, red, and brown, this stone is also found in the Emerald Mine. Supplies amount to approximately 7,000 pounds and could be sold at \$2.00 per carat.

Demantoid:—This gem, grass-green to emerald-green in color, has a diamond-like luster. It is found in commercial quantities only in Russia, and if its deposits in Sisert should prove of appreciable quantity a production of 25,000 carats per annum could be expected. Four dollars per carat is a very conservative price.

Vorobyevite:—A beautiful gold-brown variety of this gem is found at Savatievo, near Nerchinsk, Siberia. Stones of good quality amounting only to a few hundred carats a year could be expected from this pit because the primitive methods used have rendered mining operations difficult. The gem would find a market exclusively in Russia since its quality is not on a par with those produced in the United States or Madagascar.

Some of the more important of the lesser gems are the following:

Beryl:—Several deposits of this mineral are known in Russia. Beryl is found in abundance at Adui River, and in the vicinity of Lake Baikal, Siberia. At Baikal the gems found are of excellent quality. Before the war, 10,000 a year were produced and absorbed by the Russian market. There was no export of beryl.

Topaz:—This mineral comes from the Ural Mountains, Alabashka, Ekaterinburg, Miask, Ilmen Mountains, Orenburg, Nerchinsk, and Lake Baikal. Its production is negligible and the gems are sold only in the domestic market. At Lake Baikal gems of good quality are found but the output is only about 1000 carats a year.

Tourmaline:—Tourmaline of good quality is found in the Lipovskaia Mine in the Ural Mountains. Gems of a cherry-red color are produced at the rate of about 8,000 carats per year.

Amethyst:—Clear purple or bluish violet varieties are found at Mursinsky, and these deposits are famed for their excellence. Among the light-colored varieties a few dark-colored gems are found, and these are most highly valued. Production amounts to about 200 pounds per year.

Lazurite:—This gem, of azure-blue to violet-blue in color, is found in abundant quantities in the Lake Baikal region and elsewhere. Its production may reach 3,600 pounds per annum. Although the Russian lazurite is not as beautiful as the Afghanistan

variety, it is of a better quality than that produced in South America.

Nephrite:—Nephrite varies in color from white to dark green and is used extensively in the Orient for utensils as well as ornaments. It is found in extensive deposits in the Sayan Mountains. A yearly export of 20,000 pounds would be possible.

ORNAMENTAL STONES.

The ornamental stones discussed below are of minor commercial value to Russia at present although many of them are found in great abundance.

Marble Onyx:—This mineral is found in Armenia. An output of 10,000 pounds a year could easily be reached although at present only the domestic market is available.

Vesuvianite:—These stones are found abundantly in the Ural Mountains. Production is estimated at 2,000 pounds a year.

Amazonite:—Amazonite is also found in the Ural Mountains but the best mine is buried under the second track of the Trans-Siberian Railroad. An annual supply of 4,000 pounds could be obtained.

Labradorite:—A great abundance of labradorite is found in Russia and is used for ornamental purposes. Annual production reaches about 1,000 tons.

Deposits of jasper, serpentine, hornstone and jet are extensive and some of them are of very good quality. There are numerous other minerals which are used locally for ornamental and other purposes, such as aventurine, abundantly found in the Ural Mountains; obsidian from Georgia; gagat, found near Balagansk in the Irkutsk District, Siberia; and selenite from the Kama River region. Their production, however, is small and economically unimportant.

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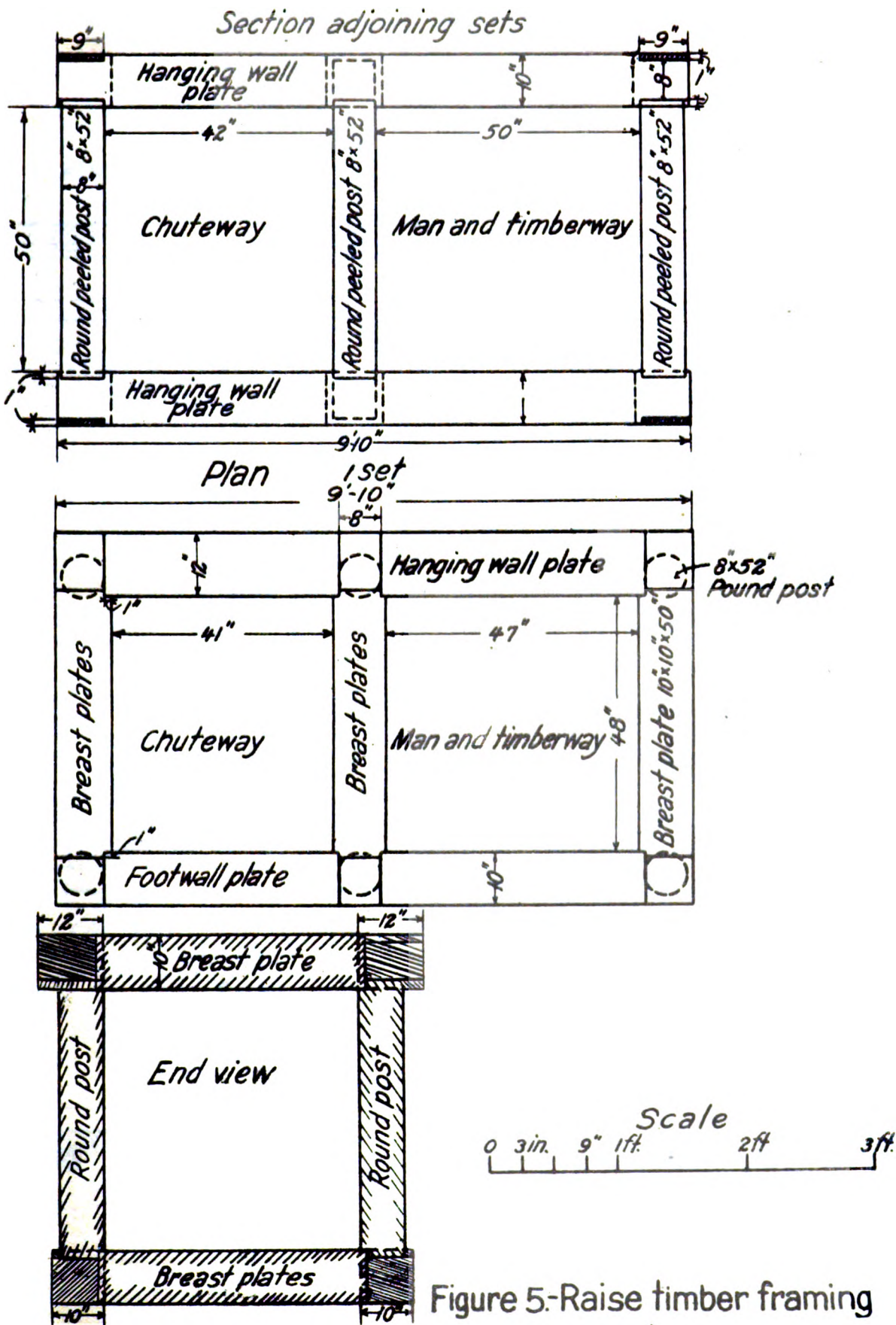


Figure 5.-Raise timber framing

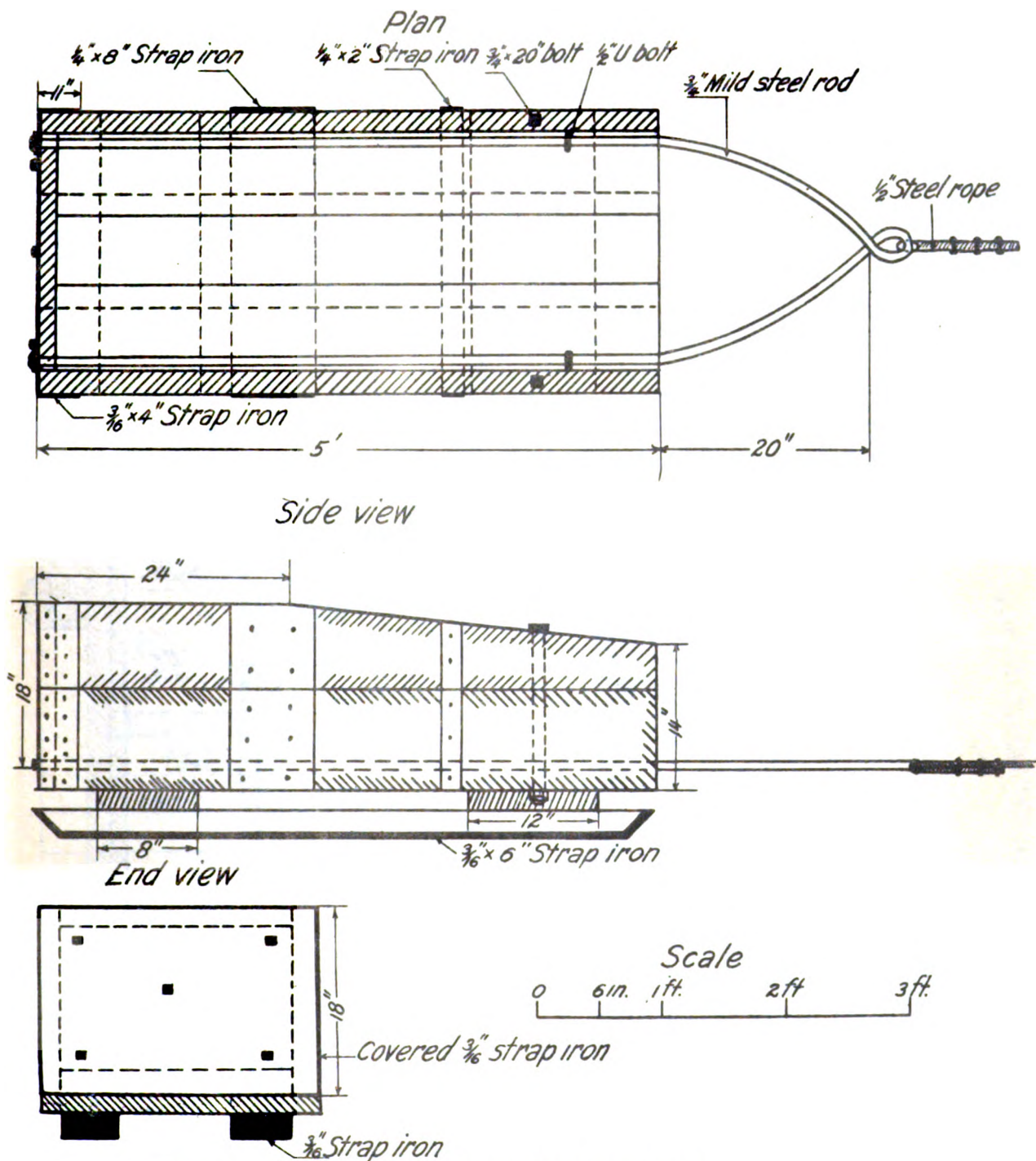
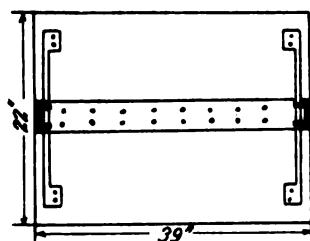
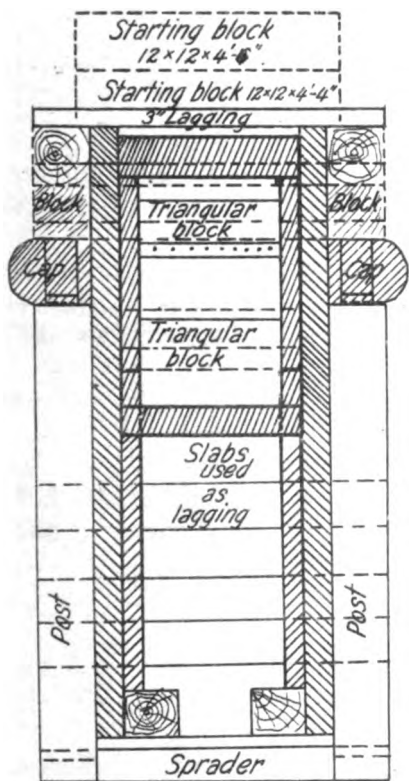
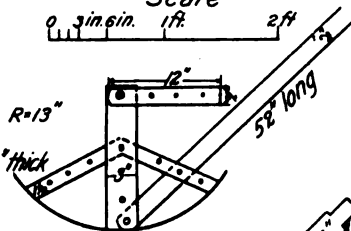


Figure 6- Timber cage for raises

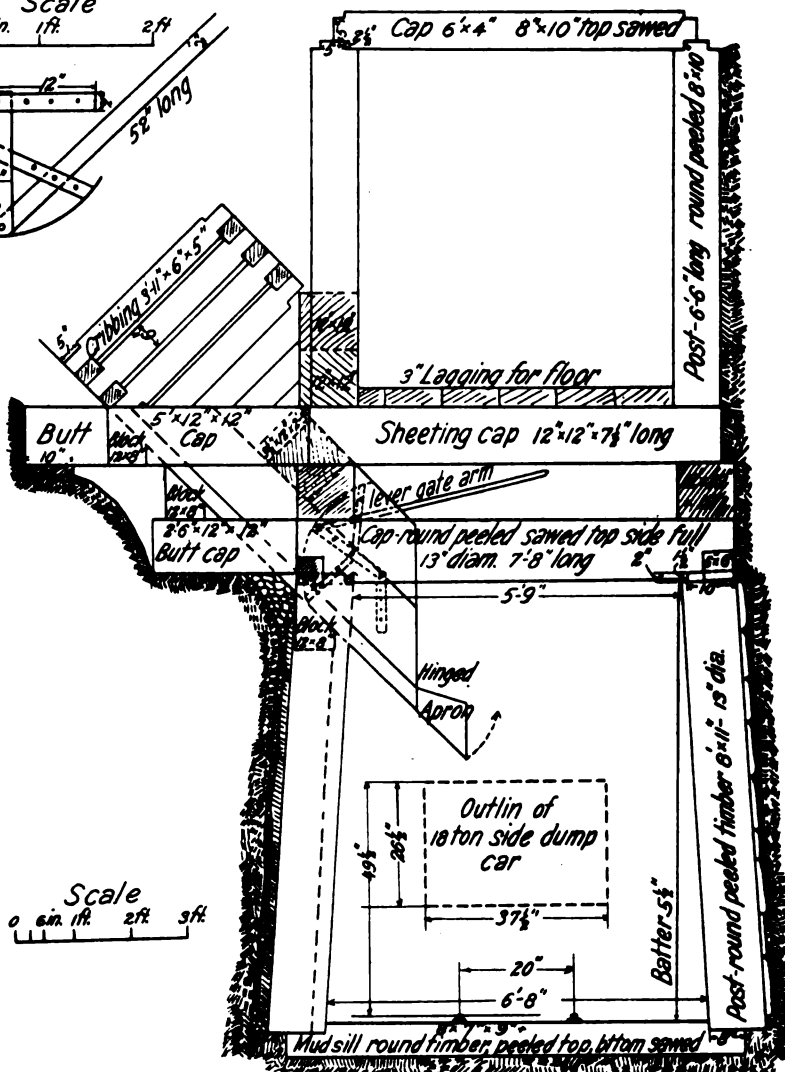
Chute gate
Plan view



Side view
Scale



Front view of drift and cribbed chuteway



Side view of drift and cribbed chuteway

Figure 7.- Standard drift set, chute and cribbed chuteway

crosscuts from drifts no turnouts or switches are laid, the broken rock being discharged directly into cars by means of a single drum tugger hoist, drag scraper and an apron to permit dumping the scraper into the car.

Underground transportation

Underground haulage is done by electric storage battery locomotives of 1.5-ton and 3.5-ton sizes. Ore cars are of steel and 32 1/2 cubic foot capacity, dump at the side, and have roller bearings. Ten cars make up a train. Skips are on wheels, and have a capacity of 2.3 tons. Supplies are sent into the mine loaded on steel flat cars or cages. These are transferred to the level station by means of a section of hinged track, and there unloaded (fig. 8). For lowering or hoisting men, a ladder arrangement is placed on a cage, so that men sit in tiers above each other, the cage being attached to the bottom of the skip by means of a large hook and a 12-foot length of 3/4-inch cable. Two independent single drum hoists are used, one having a 150-horsepower motor and a 3 by 3 foot drum, and the other a 125-horsepower motor and a 3 by 3 foot drum. Hoisting speed is 700 feet per minute.

Pumping

Pumping equipment consists of a vertical triplex plunger pump, belt-driven by a 125-horsepower motor, capable of lifting 400 gallons per minute against a head of 940 feet.

A centrifugal pump running 3,800 revolutions per minute, direct-connected to a 100-horsepower motor, and with a capacity of 300 gallons per minute, against a 700-foot head, is used as an auxiliary unit.

WAGE AND CONTRACT SYSTEMS

All ore breaking is on a wage scale basis. Wages are uniform throughout the district and are based upon a sliding scale according to the average selling price of lead. During 1929 wages were as follows:

Timbermen	\$ 6.00
Timbermen helpers	5.25
Miners	5.50
Shovellers	5.00
Motormen	5.75
Shaftmen	6.00

Practically all development is done on contract, by linear or cubic foot basis, depending on the character of work.

VENTILATION

Ventilation is natural for the main workings. Blowers are used to ventilate the shaft and new-level development work as well as any other workings which may be out of the main air course.

FIRE HAZARDS AND SAFETY METHODS

No apparent fire hazards exist in the mine. Rubbish of any kind is not allowed to accumulate at any point in the mine. Electric wiring is standard and frequently inspected.

A safety engineer is employed by the company and strict enforcement of safety rules is demanded.

The mining companies of the district jointly maintain a rescue car at Wallace, Idaho. The car carries the latest mine rescue and first aid equipment and is subject to call at all times. A Bureau of Mines safety engineer regularly employed has charge. Training in first-aid work is available to all employees in regular classes.

A monthly, quarterly, and yearly bonus is paid shift bosses and foremen having the best accident records for underground work.

Table 1 - Mining costs

Name of mine: Page mine.

Period covered: 1928

Tons of ore hoisted: 90,460

Underground costs per ton of ore mined

	Labor	Super- vision	Compressed air drills and steel	Power cost	Explo- sives	Timber	Other sup- plies	Total
Development	.72	---	.17	.03	.13	.12	---	1.17
Mining	1.43	.15	.11	.05	.11	.26	.04	2.15
Transportation underground	.13	---	---	.01	---	---	.02	.16
General underground expense	.13	---	---	.02	---	---	.03	.18
Surface expense directly applicable to underground operation	.13	---	---	.01	---	---	.02	.16
Total	2.54	.15	.28	.12	.24	.38	.11	3.88

Table 2 - Summary of costs in units of labor, power, and supplies

Name of mine: Page mine.

Period covered: 1928

Tons of ore hoisted: 90,460

Mining method: Square-set-and-fill

	<u>Development</u>	<u>Stoping</u>	<u>Total</u>
A. <u>Labor</u> (man-hours per ton)			
Drilling and blasting, timbering, and mucking	- - -	- - -	2.222
Haulage and hoisting	- - -	- - -	.267
Supervision	- - -	- - -	.236
Underground maintenance	- - -	- - -	.033
Total labor underground	- - -	- - -	2.758
Tons per man shift	- - -	- - -	2.9
Labor per cent total cost	- - -	- - -	67.5
B. <u>Power and supplies</u>			
Explosives (pounds per ton)	- - -	- - -	1.405
Timber (board feet per ton)	- - -	- - -	13.09
Power (kw.h. per ton)			
Air compression	- - -	- - -	9.423
Hoisting	- - -	- - -	2.726
Pumping	- - -	- - -	2.248
Ventilation	- - -	- - -	.430
Lighting	- - -	- - -	.239
Total	- - -	- - -	15.066
Other supplies in percentage of total supplies and power	- - -	- - -	73.5
Supplies and power percentage of total cost	- - -	- - -	32.5
C. <u>Percentage total cost</u>	30.2	69.8	100.0

Table 3. - Detail of development costs in units of labor, power, and supplies

Name of mine: Page mine

Period covered: 1928

	Development		Cross-	Raising	Total all
	Sinking	Drifting	cutting		development
Size of excavation, feet	7 by 18	8.5 by 9	5 by 7	6 by 11	
Timbered or not	Yes	Yes	Yes	Yes	
Physical properties of rocks	Hard quartzite	Soft, loose, swelling ground	Broken loose	Soft, loose vein material	
A. Labor (man hours per foot)					
Total labor (drilling, blasting, shovelling, hauling, hoisting, and supervision).....	14.34	4.8	4.8	4.8	
Feet per 8-hour man shift	.556	1.67	1.67	1.67	
B. Power and supplies (per foot)					
Explosives (pounds per foot) ...	28.2	15.7	12.9	13.6	
Timber (board feet per foot advanced).....	270	79	54	195	
Other supplies (per cent total power and supplies)	42.5	46.4	43.2	17.9	
C. Labor (per cent total cost)					
Power and supplies (per cent total cost)	63.2	58.0	58.2	40.3	
	36.8	42.0	41.8	59.7	

Table 4 - Mining in leased territory

Page mine

Year 1928

Dry tons produced	Man shifts	Tons per man shift	Average number men in lease	Grade ore		
				Ounces Ag	Per cent Pb	Per cent Zn
7,678	3,198	2.4	3	2.4	8.6	4.4

